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Educational mismatch and mortality among native-born workers in Sweden. A 19-year longitudinal study of 2.5 million over-educated, matched and under-educated individuals, 1990–2008

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Abstract This study tests the hypothesis that a disjuncture between an individual's attained level of education and that held by average workers in the individual's occupation leads to higher mortality among those with a prolonged mismatched status. Swedish register data are used in a 19-year longitudinal mortality follow-up study of all causes and specific causes of mortality. Participants were all men and women born between 1926 and 1985 who were alive on 1 September 1990, who had concurrent information on their attained level of education and the specific occupation or industry they were employed in during this period for at least a consecutive year. An objective measure of educational and occupational mismatch was constructed from these data. Those with a stable, over-educated matched, or under-educated employment status are included in the final analysis (N = 2,482,696). Independent of social, family, employers' characteristics and prior health problems, the findings from a multivariate, stratified Cox regression analysis suggest there is excessive mortality among the over-educated, and a protective effect of under-education among native-born Swedish men and women.

Keywords: educational mismatch, over-education, under-education, status incongruence, mortality

Introduction

Over the last half century researchers in the social and health sciences have shown a continued interest in the idea that the misfit between an individual′s realised position in different social status hierarchies (for example, education, occupation and income) and the individual's perception of where they ought to be positioned in each could affect their health (Bracke *et al.* 2013, Braig *et al.* 2011, Faresjo *et al.* 1997, Friedland and Price 2003, Lenski 1964, Peter *et al.* 2007). This idea emerged from the sociological concept of role conflict or strain and social comparisons with others. It was first hypothesised that social status discrepancies could motivate behaviour at both the individual and aggregate level (Benoit-Smullyan 1944), affect political orientation (Lenski 1954) and negatively affect social interactions and the establishment of social relationships (Lenski 1956).

While these original articles (Lenski 1954, 1956) never directly related low-status crystallisation – a disjuncture or status incongruence between rankings in different but parallel social status

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hierarchies – to the development of feelings of psycho-social stress, the implication was present. Lenski (1956) predicted that social pressures and frustrating, unpleasant social experiences would affect more marginalised individuals with low-status crystallisation. Nearly a decade later, stress was explicitly identified as an outcome of a status incongruence (Lenski 1964).

However, past status incongruence research has not reached a definitive conclusion about the purported negative effects on social interaction, political identification and psychological wellbeing. This was in part a result of low quality data, small sample sizes, problems with statistical methodology (Zhang 2008) and computing limitations. Early studies usually lacked statistical controls for the main effects of the status hierarchies, including education level, income and occupation (Goffman 1957, Lenski 1954, 1956). There was also little agreement about what other status hierarchies should be included in the statistical analyses (for example, race, ethnicity or gender) (Smith 1996).

Later multivariate studies usually controlled for the main effects of occupation, education and income. But it was argued that the lack of a status inconsistency effect in many studies was not necessarily the result of an absence of empirical support for the theory but rather a statistical artefact (Whitt 1983). Results from a simulation study demonstrated that earlier studies may have suffered from violations of standard ordinary least squares regression assumptions. Such violations, if they occurred, would have made it impossible to detect even a perfect relationship between status inconsistency and elevated stress with standard significance tests of the regression coefficients or with a statistical test demonstrating improvement to global model fit. Additionally, problems with statistical identification, including high correlation between the measures of position in the various status hierarchies and the computed measure of incongruence, could have also hampered the identification of a statistically significant effect.

Despite this longstanding debate over the concept's theoretical utility, the methodology and the evidence supporting or rejecting purported effects, current research has moved ahead partially as a result of improved data and alternative approaches to measuring status incongruence (Zhang 2008). A growing number of studies over the past two decades have consistently shown negative health outcomes from educational skill mismatch, a type of status incongruence. Additionally, it has been recognised that a narrow focus on simplistic, dichotomous versions of employment status are unlikely to capture the continuum of adequate and inadequate employment arrangements (Dooley 2003, Friedland and Price 2003) and the effect they are likely to have on the health of those working in contemporary labour markets.

Work and the development of psycho-social stress: conceptual frameworks

Early social-psychological research hypothesised a direct relationship between high status incongruence and the development of psycho-social stress, especially among those who were under-loaded (that is, high educational achievement and low occupational status) (House and Harkins 1975). In similar research that focused on educational mismatch it was suggested that a status panic was likely to occur among highly educated individuals who held working-class jobs where their derived social status was less than what these individuals could have expected from a job that was more commensurate with their attained level of education (Burris 1983). This disjuncture between actual and expected social status was hypothesised to lead to high psycho-social stress.

Somewhat later, the job demand–control (JDC) and the effort–reward imbalance (ERI) conceptual frameworks from occupational health hypothesised how a discordance between the demands of jobs, the quality of the workplace environment, and the expectations of the workers about fair rewards for work effort could produce health damaging stress (Karasek 1979, Karasek and Theorell 1990, Siegrist 1996, 1998). While there are distinct tensions between these two frameworks, particularly concerning the role that individual coping skills have in nullifying or magnifying the

harmful effects of a stressful working environment, synergy between the JDC and the ERI frameworks is evident. Both can be adapted to suggest that having more (or less) education or skill than is required by a worker's occupation could produce high stress that in turn could lead to health problems. This would occur where psycho-social stress arises out of an imbalance between job demands and job decision control, or high effort and substandard compensation or rewards, including esteem, job security and promotion opportunities. Over-educated workers employed in so-called passive jobs or in jobs where the rewards are low relative to what a worker could expect in a job that required their level of education would be especially vulnerable.

The JDC framework suggests that work demands, employee engagement and job decision latitude about how previously attained education and skills are utilised on the job are all concurrently low in passive jobs (Karasek 1979). It has also been proposed that those who work in passive, unstimulating jobs can become both depressed and more inclined to engage in maladaptive coping behaviour (for example, excessive drinking, smoking, drug taking and bingeing) that leads to poor health and elevated mortality (Amick *et al.* 2002, Karasek 1979, Kouvonen *et al.* 2005).

While the ERI framework pays attention to the rewards of work and the coping characteristics of individuals rather than the control structure of the employment context, the prediction about the negative health effects of an effort–reward imbalance can be extended to over-educated individuals without contradicting JDC predictions. This framework postulates that health-harming stress would develop among over-educated people if an income penalty is experienced by itself or in combination with reduced social status or limited job promotion opportunities. The negative health effect of an effort–reward imbalance would also be magnified in individuals who exhibit a tendency to over-commitment or excessive striving for approval and social status (van Vegchel *et al.* 2005).

Several empirical studies have shown that over-educated people experienced a substantial wage penalty relative to those whose educational attainment matched the requirements of their job (Chiswick and Miller 2010, Hartog 2000, Korpi and Tåhlin 2009). In Sweden over-educated indviduals did not recover from this initial penalty over time and it remained after controlling for differences in ability (Korpi and Tåhlin 2009). Earnings penalties were also found for both native-born Swedish men and women in a similar study. It utilised cross-sectional data on educational mismatch between the field of university study and the individual's occupation with easily identifiable university degree requirements (Nordin *et al.* 2010). The earnings penalty was larger for men. The findings also suggest that differences in cognitive ability did not explain the penalty for mismatched men. The study did not have a measure of cognitive ability for women.

In the case of under-educated workers both conceptual frameworks could be extended to link a less than average level of educational attainment in an occupation to harmful psycho-social stress. The JDC framework also predicts that any employer-imposed constraint on the opportunity and the discretion of employees to pursue new skills, additional education or training will trigger high work stress if job demands are also high. This employment arrangement was, in fact, predicted to be the most toxic and stress provoking of all, especially if adequate social support was lacking (Johnson and Hall 1988). While the ERI framework focuses less on the structural aspects of employment it pays some attention to the extrinsic demands or obligations of work (van Vegchel *et al.* 2005). High work demands in terms of skill or educational requirements coupled with low rewards could expose any under-educated worker with a tendency for over-commitment to harmful levels of psycho-social stress.

The ERI framework explicitly states that the risk of stress-related disorders increases with long-term exposure to an effort–reward imbalance in the workplace (Siegrist 2005). In the original formulation of the JDC framework no explicit health-related predictions were made about the exposure time to high demand and low control work contexts (Karasek 1979). But as the

allostatic load theory (Sterling and Eyer 1988) has gained broader acceptance, research that has used the JDC framework has explicitly (Steptoe and Marmot 2003) and implicitly (Smith and Bielecky 2012) incorporated the idea that negative work-related stress experienced over a prolonged period of time leads to negative health consequences. In the context of educational mismatch, an extension of the implied and explicit predictions of these two frameworks could be used to suggest that significant health consequences will accumulate as a result of a long-term rather than transient experience of a mismatched status.

For over-educated workers another potential source of health-damaging stress could arise from the recognition that a specialised skill set may depreciate in value and skill efficiency declines when it has not been used (De Grip and Van Loo 2002) or has been underutilised in the workplace. There is some empirical support for this idea in terms of cognitive decline among over-educated workers, including reduced verbal fluency and a decline in their immediate and delayed recall abilities as well as reduced cognitive flexibility among under-educated people (De Grip *et al.* 2008). Those who have spent considerable time, effort and resources to develop such skill sets through formal education would be especially vulnerable.

Mental health effects of status incongruence or educational mismatch

Most studies that have examined the health consequences of status incongruence or educational mismatch have used a measure of mental health status as an outcome. Their findings suggested that mismatched individuals experienced reduced psychological wellbeing, increased distress or shame (Cassidy and Wright 2008, Johnson and Johnson 1996, Lundberg *et al.* 2009) and more depressive symptoms (Friedland and Price 2003, Johnson and Johnson 1997) relative to those who were matched. A recent cross-sectional, cross-national study showed high depressive symptom reporting among over-educated people but not among under-educated workers (Bracke *et al.* 2013).

Health effects of over-qualification or under-employment

Other studies based primarily on survey data have made comparisons of psychological distress, physical and self-rated health between matched and qualified employees and those classified as over-qualified or under-employed. A cross-sectional study of American postal workers found that those who perceived themselves to be over-qualified reported greater mental distress than the rest (Johnson and Johnson 1996). At least two other studies based on longitudinal designs have demonstrated declines in self-rated health among over-qualified people (Johnson and Johnson 1999, Smith and Frank 2005). Findings from an additional study with a sampling frame that included many respondents who were not active in the labour market suggested there was reduced functional health and higher levels of chronic disease among those who were income or status under-employed. An association to negative physical health was not evident in those who were skill or hours (fewer than desired) under-employed. However, those who were classified as over-employed reported more chronic disease than the adequately employed (Friedland and Price 2003).

The literature on the health effects of under-employment is substantial and includes studies on the effects of unemployment (Garcy and Vågerö 2012, 2013) and inadequate employment, including hours (that is, limited working hours or time-dependent contract length) (Winefield *et al.* 1991), pecuniary under-employment (Feldman *et al.* 2002) and skill under-employment. Studies that have focused on skill under-employment among mostly American male expatriates and executives have shown a negative impact on their reported mental health and anxiety levels (Bolino and Feldman 2000) and the development of a sense of relative deprivation (Feldman *et al.* 2002). Studies with a focus on immigrants have similarly shown a decline in their mental health (Dean and Wilson 2009, Reid 2012) and increased depression, anxiety, agitation and irritability (Dean and Wilson 2009).

Status inconsistency and cardiovascular disease

A smaller group of studies has focused on the association between status inconsistency and the risk of ischaemic heart disease (IHD) and stroke. Two studies based on German cohorts that were not representative of the population reported higher cardiovascular disease (CVD) and IHD risk among participants (Braig *et al.* 2011, Peter *et al.* 2007). The earlier study measured three different types of status inconsistency including over-eduction and under-education, and two types of income-related measures of status inconsistency. Hazard ratios (> 3) related to hospitalisation for IHD were found for both men and women who had been classified as over-educated. The later study found an elevated odds ratio (OR) of CVD for over-educated men (OR 1.2, 95% CI 0.8, 1.2) and under-educated men (OR 1.8; 95% CI 1.4, 2.3) after controlling for a variety of factors including smoking, drinking, physical activity, diabetes and body mass index. There was no association for mismatched women.

Over-education and mortality

To date there have been only two studies related to mortality and educational mismatch. The first was based on a 22-year follow-up of a small cohort of Swedish men at the age of 50, born in 1913. The results suggested higher OR of all causes and IHD mortality among status-incongruent men who could also have been classified as over-educated (Faresjo *et al.* 1997). Cancer mortality was also elevated among these men. The result was not statistically significant. Multivariate controls included indicators for smoking and drinking as well as controls for prior IHD risk factors at age 50.

The later study (Smith *et al.* 2012) included a nationally representative Canadian 15% sample of individuals aged 25 to 64 years with a mortality follow up from 1991 to 2001. Cox proportional hazard regression was used. Models included controls for age, community size, educational attainment (four categories), ethnicity or aboriginal origin, a measure of income adequacy, marital status, occupational class (five categories), province of residency and the number of years since immigration.

The study's assessment of over-qualification and under-qualification was based on a set of multiplicative interaction terms between the occupational class categories and the categories of educational attainment. Each occupational class category was based on an assessment of minimum training or education requirements for the general group of occupations included in each. Over-qualified individuals had a higher level of educational attainment than was required in their general occupational category. Presumably, under-qualified individuals had a lower educational attainment than was required.

The results suggested there was marginally elevated mortality from all causes of death and CVD among over-qualified men (all causes: HR 1.06; 95% CI 1.01, 1.12; CVD: HR 1.05; 95% CI 0.96, 1.15) and women (all causes: HR 1.04; 95% CI 0.96, 1.13; CVD: HR 1.19; 95% CI 0.98, 1.46). There was slightly lower mortality among under-qualified people with the exception of under-qualified women, who had marginally elevated mortality from all causes. Given the statistically non-significant results, the study concluded that over-qualification was not associated with excess all-causes and CVD mortality.

Limitations of the literature

There are several limitations of these studies. Because most were small it is feasible that their reduced statistical power made it difficult to detect the full health and mortality effects of mismatch (De Grip *et al.* 2008, Faresjo *et al.* 1997, Friedland and Price 2003, Johnson and Johnson 1999). Almost all have limited generalisability because their sample or cohort designs were not nationally representative (Braig *et al.* 2011, Faresjo *et al.* 1997, Friedland and Price 2003, Lundberg *et al.* 2009, Peter *et al.* 2007). The cross-sectional design of some of these

studies restrict causal inference about the role that a mismatch could have in the development and reporting of health problems (Bracke *et al.* 2013, Lundberg *et al.* 2009). In several of the studies simultaneous statistical control of the main effect of each status hierarchy (education, occupation and income) is missing or appears to be missing in the multivariate analyses (Braig *et al.* 2011, Cassidy and Wright 2008, Faresjo *et al.* 1997, Lundberg *et al.* 2009, Peter *et al.* 2007). This practise had been criticised (Whitt 1983, Zhang 2008).

Finally, many but not all of these recent studies have utilised measures of mismatch that were based on a hierarchical ranking of a categorised, attained education level and a general social class schema (*see* Braig *et al.* 2011, Faresjo *et al.* 1997, Lundberg *et al.* 2009, Peter *et al.* 2007, Smith and Frank 2005, Smith *et al.* 2012). The classification of individuals as matched or mismatched often appeared to be inconsistent as there was little standardisation in the criteria used to make the determination. In the case of the two German studies, both utilised measures of status-inconsistency based on deviation scores between the various vertical status hierarchies where each was ranked on a five-point scale. Status-inconsistent individuals were classified as such if they had deviation scores of > 2, without a specific justification for the use of this threshold value (see Braig *et al.* 2011, Peter *et al.* 2007).

Hypotheses

Based upon theoretical postulations and findings from empirical research four assumptions underlie the research hypotheses of this study. The first three are: (i) mismatched individuals must perceive elevated psycho-social stress when they are exposed to a status discrepancy by itself or in combination with an income penalty or effort–reward imbalance, (ii) a mismatch between job demands, employee expectations and acquired education or skills can produce high levels of psycho-social stress, especially if employer constraints are placed on a worker's opportunity to obtain additional skills, training or education, (iii) prolonged work-related psycho-social stress can cause significant morbidity that could eventually lead to death.

Accumulating empirical evidence has offered substantial support for all three assumptions in relation to the development of IHD and mental health problems (Belkic *et al.* 2004, Hemingway and Marmot 1999, Stansfeld *et al.* 1999). Neither the JDC nor the ERI framework provides firm guidance on which state of mismatch is more damaging to health. Findings from the reviewed literature have consistently pointed to negative health outcomes for workers who could have been broadly classified as over-educated or under-employed. Negative health effects occurred less frequently for under-educated individuals. If over-educated people are more likely to concurrently experience a status discrepancy and earnings penalty, while realising the depreciating value of their skills and educational experience, a fourth assumption is reasonable: (iv) the level of psychosocial stress should be highest among over-educated people. Based on these four assumptions the following may be expected:

Hypothesis 1: A disjuncture between an individual's attained level of education and that held by average workers in that individual's occupation can lead to higher mortality among those who experience a prolonged mismatched status.
Hypothesis 2: Mortality will be higher among over-educated individuals whose status remains stable over time than in those who have a stable matched status.
Hypothesis 3: Mortality will be higher among over-educated individuals whose status remains stable over time than in those who have a stable under-educated status.
Hypothesis 4: Mortality will be higher among under-educated individuals whose status remains stable over time than in those who have a stable matched status.

Data and methods

Register data compiled in the Swedish work and mortality database were used in the study. This database, housed at the Centre for Health Equity Studies in Stockholm, contains information from several national registries including the 1990 Census, the in-patient registry (1981–2008), the cause-of-death registry (1990–2008), and the *Longitudinell integrationsdatabas för Sjukförsäkrings och Arbetsmarknadstudier* (longitudinal integrated database for sickness insurance and labor market studies) registry (1990–2008). These registers are linked at the individual level by Statistics Sweden.

All individuals (n = 6,971,966) born between 1926 and 1985 who were living in Sweden for some time between 1990 and 2008 and were still alive on 1 September 1990 were eligible for the study. All men and women who had concurrent information on their attained level of education and the specific occupation they were employed in for at least 1 year during this period were eligible. Individuals who were unemployed for 19 consecutive years were excluded from the study because no specific information on their occupation or industry existed.

Only those with a stable over-educated, matched or under-educated status between 1990 to 2008 were included in the final analyses (n = 2,482,680). This strategy allows for an unambiguous comparison between matched and mismatched workers. Individuals who experienced spells of unemployment were included as long as any subsequent matched or mismatched status was not different from their status prior to the period of unemployment. Individuals who lacked employment information prior to or after they were first classified as matched or mismatched were also included as long as their mismatched status had not changed after the initial classification. Finally, those individuals who were 65 years or older at the study entry were excluded in a given analysis year to prevent the inclusion of those who were close to retirement and may have had low attachment to the labour force. Generally, such individuals would have had only a single year of employment and education information. In this study I focus on native-born Swedish workers.

Dependent variables

All causes and specific causes of mortality are the outcomes of interest including cancer mortality, all circulatory diseases (CD, IHD, stroke), suicide and alcohol-related disease mortality. *International Classification of Diseases* codes were given in vers. 9 and 10 (see Appendix 1).

Measurement of educational mismatch

An objective measure of educational mismatch is used in this study. It is similar to Clogg and Shockey's (1984) realised matches (RM) method. The RM method compares the population distribution of years of attained education of all employees in an occupation with the years of attained education of an individual employee in the same occupation. Cut-off points are usually set so that over-educated people have an attained education level at least one standard deviation above the mean level while under-educated people have attainment at least one standard deviation below the mean level.

Information on attained years of individual-level education was not available. The measure of educational mismatch used in this study, however, was developed with comparable alternative data. It utilises both ordered categorical information on the highest level of completed education (the adapted international standard classification of education coding) at the end of the spring in a given year and data on an individual′s five-digit occupation or industry code usually reported between September and November of the same year.

In contrast to a rank ordered approach where occupations are grouped into a class schema, the use of a specific occupation or industry provides a detailed method of classification. A

measure based on a social class schema obscures differences in the degree of educational mismatch present in specific occupations categorised in the same social class level (for example, Smith *et al.* 2012). For example, this is evident if the occupations of taxi driver and freight transport driver (lorry) are considered. In Sweden, among native-born men with a stable mismatched status in 2008, a higher percentage of taxi-drivers (23%) than lorry drivers (10%) were found to be over-educated. According to a typical social class schema both would be categorised as skilled manual occupations.

The category of education that occurs most often (the mode) for each five-digit occupational category was computed for all occupations in every year (1990–2008) using data from the entire Swedish population. A comparison was then made between an individual's attained level of education and the modal level of attained education in the individual's occupation for each year that both sources of information were available. In a given year a worker could be classified as under-educated if they had attained less than the modal value of education in their occupation, over-educated if they had completed education higher than the modal value, or matched if they had the same level of education. A final dichotomous summary measure for each status was then created if a worker's status had remained stable over time (if, for example, they were always over-educated). As discussed earlier, the strategy of including only those with a stable status is based on the assumption that health and mortality consequences occur when individuals experience long-term psycho-social stress.

Social, family, and employer characteristics (SFE)

An indicator was also created to assess the year in which the person could first be classified as over-educated, matched or under-educated. This indicator was used to select baseline SFE information for the worker that corresponded to the individual's first classification year as matched or mismatched. This information, in addition to birth month and year, was used to create controls for confounders or predictors of mortality, including gender, marital status, education level, the logged total number of children, the logged total income including earned and work-related benefits (for example, sick pay, worker's compensation, parental benefits), the employer's county of location and each person's employment sector. A measure of total cumulative unemployment experience from 1990 until the time of death, censoring or exit from Sweden was also included.

The employer county location was used as a proxy for the geographical location and the size of the area a worker was located close to. Employment sector was used as a proxy indicator for the individual's occupation or industry to avoid potential collinearity between the measure of educational mismatch and the main effect of occupation. Individuals were grouped into 12 5-year birth-cohort intervals (1926–1985) with the exception of the oldest cohort, six education-level categories (pre-secondary upper school, < 9 years; 9–10 years presecondary upper school; ≤ 2 years secondary upper school; > 2 to maximum of 3 years secondary upper school; post-secondary upper school, < 3 years; post-secondary upper school, > 3 years or researcher education), five marital-status categories, nine employer county location indicators and 18 employment sectors. A small percentage of individuals had missing information on the employer's county location. A dummy variable representing a missing status was included. All other information was complete.

Medical hospitalisation history and mortality outcomes

To control for the possibility that prior poor health status could contribute to an individual's mismatched status a cumulative measure of the logged total number of hospitalisations an individual experienced until the time of first classification as over-educated, matched or

under-educated was computed. Codes given at admission and throughout a hospitalisation until discharge were available from the beginning of 1981 until the end of 2008.

The use of hospitalisation is likely to be a conservative measure of prior poor health status since it typically represents a severe level of illness. This is more likely if a limited time span of information is available. Given this study's very long follow-up of hospitalisation history prior to the first potential occurrence of mismatch in 1990, this concern is less relevant. However, there are at least two studies based on Swedish survey data from 1980 and 1990 that have suggested that inpatient care (hospitalisation weeks) utilisation probability and frequency varied by income but not by geographical area, location size or by years of education (Gerdtham 1997, Gerdtham and Sundberg 1998). Their results related to income, however, appeared to be highly sensitive to the inclusion of outliers with more than 10 hospital-care weeks.

A sensitivity analysis was run to assess the potential interactive effect between hospitalisation, income, employer county regional location and education level for men and women. The mortality estimates for mismatched men and women from these higher order specifications did not change in any appreciable way and are not shown.

Statistical models

Multivariate, Cox regression was used. The month and the year of death and information on the date of exit from Sweden were available. The time scale is attained age at the end of 2008, age at the date of exit from Sweden or age at the time of death. Attained age is measured in years and months. Models account for different entry ages where the first exposure to the status of being over-educated, matched or under-educated occurred. All analyses are stratified by gender because Swedish men and women are concentrated in different occupations and industry sectors. Additionally, age-cohort stratified analyses were run for all causes of death.

Three sets of models were estimated for all causes of mortality and each specific cause of death. The first set of models is minimally adjusted. The second set adjusts for SFE information while the third adds the measure of prior health status. Mortality estimates for the over-educated and under-educated people are reported separately in each table. In all analyses the contrast group included native-born individuals who were always matched.

Results

The number of deaths between September 1990 until the end of December 2008 among men and women is shown in Table 1. Descriptive results are shown in Table 2. Nearly a quarter of the male sample was over-educated. Most men and women in the sample were classified as under-educated. Compared with other birth cohorts a larger proportion of men born between 1940 and 1969 were over-educated. A disproportionate share of young women born between 1960 and 1979 were over-educated. Under-educated men and women were disproportionately represented among the oldest and youngest birth cohorts. Over-educated men were disproportionately married and over-educated women were disproportionately unmarried. Multiple comparisons between the marital status categories using Bonferroni *t*-tests suggested that most mean differences were > 0, ($t = 2.8$, $\alpha = .05$, male d.f. 1,254,423, female d.f. 871,628) with the exception of the contrasts between the mean percentage of those with some other marital status and the other four marital status categories. Finally, relative to those who were always matched, over-educated women had lower average income ($t = -45.64$, $P < 0.0001$, d.f. = 192,089) while over-educated men had higher average income ($t = 17.09$, $P < 0.0001$, d.f. = 494,857) over time.

Table 1 *Number and causes of death 1990–2008, for over-educated, matched and under-educated native-born Swedish men and women, born 1926–1985*

	Deaths (n)			
Causes of death	*Total deaths*	*Over-educated*	*Matched*	*Under-educated*
Men				
All causes	140,625	26,596	37,045	76,984
Cancer	46,872	9,827	11,524	25,521
All circulatory disease	48,085	8,460	11,880	27,745
Ischaemic heart disease	30,896	5,257	7,564	18,075
Stroke	7,702	1,447	1,927	4,328
Alcohol-related disease	5,634	911	1,802	2,921
Suicides	7,053	1,418	2,519	3,116
Women				
All causes	79,035	9,869	26,394	42,772
Cancer	40,461	5,399	13,769	21,293
All circulatory disease	17,244	1,646	5,446	10,152
Ischaemic heart disease	8,435	761	2,623	5,051
Stroke	4,665	510	1,546	2,609
Alcohol-related disease	1,484	220	492	772
Suicides	2,350	546	885	919

Men

For both over-educated and under-educated men, model 1 (Table 3) suggests that there is a lower hazard of mortality from all causes and specific causes of death relative to matched men. The only exception is for under-educated workers who died from IHD (HR 0.98, 95% CI 0.95, 1.00). With the addition of the controls for SFE characteristics (model 2) excessive mortality effects become apparent for over-educated workers while the protective effect of being under-educated strengthens. Likelihood ratio testing suggests improvements to the fit of all models with the inclusion of the indicators for SFE.

There is an attenuation in the hazard of mortality from over-education for all causes and specific causes of death after adjustment for prior poor health status in model 3. Controlling for prior poor health strengthens the protective effect of being under educated for all causes, IHD and alcohol-related causes. Mortality related to all causes (HR 0.84, 95% CI 0.81, 0.86) and nearly all specific causes of death including cancer-related mortality (HR 0.89, 95% CI 0.84, 0.94), CD-related mortality (HR 0.84, 95% CI 0.80, 0.89), IHD (HR 0.83, 95% CI 0.77, 0.88), alcohol-related causes (HR 0.62, 95% CI 0.52, 0.73) and suicide (HR 0.72, 95% CI 0.62, 0.84) is lower among under-educated men. Again, likelihood ratio testing indicates improvement to the fit of all the individual mortality models with the addition of the prior health status measure.

Mortality related to CD and IHD are marginally elevated for over-educated men (HR 1.04, 95% CI 0.99, 1.09; HR 1.06, 95% CI 0.99, 1.13). For over-educated men there is an excess hazard of all cause (HR 1.12, 95% CI 1.08, 1.15), cancer-related mortality (HR 1.05, 95% CI 1.00, 1.10), alcohol-related mortality (HR 1.60, 95% CI 1.36, 1.89) and suicide (HR 1.47, 95% CI 1.29, 1.70). Age cohort stratified models for all causes of death (Table 4) suggest that the hazard of mortality from over-education was attributable to working-age men born between 1940 and 1969.

Table 2 *Selected descriptive characteristics, over-educated, matched and under-educated native-born Swedish men and women, born 1926–1985*

	Men				*Women*			
Age cohort	*n*	*% over-educated*	*% matched*	*% under-educated*	*n*	*% over-educated*	*% matched*	*% under-educated*
1926–1929	54,759	20.16	19.89	59.94	54,374	9.62	29.34	61.03
1930–1934	111,658	19.73	20.40	59.87	113,763	10.10	30.68	59.22
1935–1939	125,463	20.78	21.21	58.01	117,001	10.37	30.92	58.71
1940–1944	156,688	22.55	24.77	52.68	127,845	10.19	32.98	56.83
1945–1949	172,857	25.32	28.70	45.98	125,380	12.06	37.53	50.41
1950–1954	141,229	25.49	33.49	41.02	84,976	15.72	41.29	42.99
1955–1959	128,206	21.61	43.02	35.37	66,283	17.43	42.67	39.90
1960–1964	120,060	21.33	49.64	29.03	58,048	22.14	44.10	33.77
1965–1969	111,300	22.10	55.18	22.72	51,129	29.52	41.09	29.40
1970–1974	57,296	17.03	48.54	34.43	24,779	25.04	31.23	43.73
1975–1979	31,116	28.19	7.29	64.52	18,088	24.62	7.15	68.23
1980–1985	43,796	20.89	9.52	69.59	29,967	16.07	12.45	71.48
Married	618,367	24.47	28.59	46.94	506,154	11.72	35.26	53.02
Unmarried	531,382	20.34	37.89	41.77	241,294	21.57	32.66	45.77
Divorced	96,583	19.54	27.40	53.06	95,236	12.25	35.00	52.75
Widowed	8,087	19.30	22.57	58.13	28,941	7.91	28.97	63.11
Other marital status	9	22.22	33.33	44.44	8	12.50	12.50	75.00
Presecondary upper school, < 9 years	288,693	0.00	0.92	99.08	221,504	0.00	1.27	98.73
9–10 years presecondary upper school	254,232	0.36	0.83	98.81	181,174	0.29	1.52	98.19
≤ 2 years secondary upper school	365,009	0.46	95.61	3.93	251,249	0.69	85.44	13.87
> 2 to max 3 years. secondary upper school	150,706	91.68	3.88	4.45	68,116	75.21	13.17	11.62

(continued)

Table 2 *(continued)*

	Men				*Women*			
Age cohort	*n*	*% over-educated*	*% matched*	*% under-educated*	*n*	*% over-educated*	*% matched*	*% under-educated*
Post-secondary upper school, < 3 years	100,880	79.70	10.48	9.82	61,712	78.74	8.31	12.94
Post-secondary upper school, > 3 years/ reseacher education	94 908	61.82	38.18	0.00	87,878	26.44	73.56	0.00
Over-educated (*n*)	279,827				125,324			
Matched (*n*)	406,422				298,995			
Under-educated (*n*)	568,179				447,314			
Total number of hospitalisations (mean)	1.41	1.33	1.37	1.47	1.71	1.65	1.77	1.69
Total number of children (mean)	1.76	1.82	1.77	1.73	1.71	1.72	1.78	1.67
Total individual income (in SEK) (median)	160,517	181,001	159,901	150,901	112,824	123,001	124,601	102,101
Total number	1,254,428				871,633			

Table 3 *All causes and selected causes of mortality 1990–2008, over-educated and under-educated native-born Swedish men, born 1926–1985 (N* = 1,451,355)

	Model 1[a]		*Model 2*[b]		*Model 3*[c]	
	HR	*95% CI*	*HR*	*95% CI*	*HR*	*95% CI*
Over-educated men						
Matched (Ref.)	1.00		1.00		1.00	
All causes	0.81	0.80, 0.83	1.14	1.10, 1.17	1.12	1.08, 1.15
Cancer	0.92	0.89, 0.94	1.05	1.00, 1.11	1.05	1.00, 1.10
All circulatory disease	0.76	0.74, 0.78	1.06	1.01, 1.12	1.04	0.99, 1.09
Ischaemic heart disease	0.74	0.72, 0.77	1.08	1.02, 1.16	1.06	0.99, 1.13
Stroke	0.80	0.75, 0.85	1.00	0.89, 1.14	0.99	0.87, 1.12
Alcohol-related disease	0.63	0.58, 0.68	1.79	1.51, 2.13	1.60	1.36, 1.89
Suicide	0.85	0.79, 0.90	1.53	1.34, 1.76	1.47	1.29, 1.70
Under-educated men						
Matched (Ref.)	1.00		1.00		1.00	
All causes	0.94	0.93, 0.95	0.83	0.81, 0.86	0.84	0.81, 0.86
Cancer	0.92	0.90, 0.94	0.89	0.84, 0.94	0.89	0.84, 0.94
All circulatory disease	0.96	0.94, 0.98	0.84	0.79, 0.88	0.84	0.80, 0.89
Ischaemic heart disease	0.98	0.95, 1.00	0.82	0.77, 0.88	0.83	0.77, 0.88
Stroke	0.91	0.86, 0.96	0.89	0.78, 1.01	0.89	0.78, 1.01
Alcohol-related disease	0.91	0.86, 0.97	0.59	0.50, 0.70	0.62	0.52, 0.73
Suicide	0.91	0.87, 0.97	0.72	0.62, 0.84	0.72	0.62, 0.84
−2 Log likelihood ratio tests						
	Chi-squared[d]	d.f.	*P* <	Chi-squared[e]	d.f.	*P* <
All causes	20930.4	37	.0005	16809.7	1	.0005
Cancer	8081.6	37	.0005	6241.0	1	.0005
All circulatory disease	5678.9	37	.0005	4619.8	1	.0005
Ischaemic heart disease	1134.4	37	.0005	691.0	1	.0005
Stroke	6248.4	37	.0005	2842.4	1	.0005
Alcohol-related disease	1517.5	37	.0005	994.5	1	.0005
Suicide	1950.2	37	.0005	685.9	1	.0005

Note: HR, hazard ratio, CI, confidence interval.
[a]Adjusted for birth cohort, over-educated status, under-educated status, foreign born status, interaction term (foreign born*over-educated), interaction term (foreign born*under-educated).
[b]Additional adjustment for the natural logarithm (no. of children), marital status, natural logarithm (total income), education level, total cumulative unemployment experience 1990–2008, employer county location, and employer industry sector.
[c]Additional adjustment for natural logarithm (no. of total hospitalisations).
[d]Compares (−2LL Model 2 – −2LL Model 1); test statistics are identical for the over-educated and under-educated.
[e]Compares (−2LL Model 3 – −2LL Model 2); test statistics are identical for the over-educated and under-educated.

Women

For over-educated and under-educated women model 1 does not uniformly suggest lower mortality across all causes and specific causes of death (Table 5). Once the SFE characteristics have been included (model 2) there is both an increase and emergence of an excess hazard of mortality from an over-educated status while the protective effect of being under-educated becomes consistent across all causes and specific causes of death. Likelihood ratio testing

Table 4 *All causes of mortality 1990–2008, age cohort stratified, over-educated native-born Swedish men and women, born 1926–1985*

Age cohort	*HR*[a]	*95% CI*	*n*[b]
Over-educated men			
1926–1929	0.91	0.80, 0.97	54,759
1930–1934	0.92	0.86, 0.97	111,658
1935–1939	1.04	0.97, 1.12	125,463
1940–1944	1.31	1.21, 1.41	156,688
1945–1949	1.50	1.38, 1.64	172,857
1950–1954	1.81	1.59, 2.05	141,229
1955–1959	1.83	1.54, 2.17	128,206
1960–1964	1.60	1.28, 2.00	120,060
1965–1969	2.34	1.60, 3.43	111,300
1970–1974	0.89	0.55, 1.44	57,296
1975–1979	0.52	0.30, 0.90	31,116
1980–1985	0.58	0.34, 0.99	43,796
Over-educated women			
1926–1929	0.93	0.84, 1.04	54,374
1930–1934	1.10	1.01, 1.20	113,763
1935–1939	1.14	1.04, 1.26	117,001
1940–1944	1.75	1.60, 1.92	127,845
1945–1949	1.90	1.72, 2.10	125,380
1950–1954	2.18	1.89, 2.51	84,976
1955–1959	2.04	1.68, 2.46	66,283
1960–1964	1.59	1.24, 2.04	58,048
1965–1969	1.45	1.01, 2.08	51,129
1970–1974	1.42	0.77, 2.62	24,779
1975–1979	1.02	0.43, 2.46	18,088
1980–1985	1.14	0.43, 2.99	29,967

Note: HR, hazard ratio, CI, confidence interval.
[a]Adjusted for an over-educated status, under-educated status, foreign born status, interaction term (foreign born*over-educated), interaction term (foreign born*under-educated), natural logarithm (no. of children), marital status, natural logarithm (total income), education level, total cumulative unemployment experience 1990–2008, employer county location, employer industry sector, and the natural logarithm (no. of total hospitalisations).
[b]The time scale used in these analyses was rounded to increase estimation speed.

clearly indicates that model fit improved with the addition of this set of confounders and predictors.

The excess hazard from an over-educated status is marginally reduced for most causes of death with the exception of alcohol-related causes and suicide once the indicator for prior poor health is included in model 3. For under-educated women, holding constant the effect of prior poor health appears to strengthen the protective effect of being under-educated.

Estimates from model 3 suggest mortality related to all causes (HR 0.81, 95% CI 0.78, 0.84) and each of the specific causes of death including cancer-related mortality (HR 0.83, 95% CI 0.80, 0.87), CD-related mortality (HR 0.81, 95% CI 0.76, 0.87), IHD (HR 0.80, 95% CI 0.72, 0.88), stroke (HR 0.73, 95% CI 0.63, 0.83) alcohol-related causes (HR 0.67, 95% CI 0.52, 0.85) and suicide (HR 0.74, 95% CI 0.61, 0.90) is lower among under-educated women.

Table 5 *All causes and selected causes of mortality 1990–2008, over-educated and under-educated native-born Swedish women, born 1926–1985 (N* = 1,031,341)

	Model 1[a]		*Model 2*[b]		*Model 3*[c]	
	HR	*95% CI*	*HR*	*95% CI*	*HR*	*95% CI*
Over-educated women						
Matched (Ref.)	1.00		1.00		1.00	
All causes	1.10	1.08, 1.13	1.41	1.36, 1.47	1.40	1.35, 1.45
Cancer	1.18	1.14, 1.22	1.39	1.32, 1.46	1.38	1.31, 1.45
All circulatory disease	0.91	0.86, 0.96	1.35	1.23, 1.47	1.33	1.21, 1.46
Ischaemic heart disease	0.88	0.81, 0.95	1.39	1.22, 1.59	1.36	1.19, 1.57
Stroke	0.99	0.90, 1.09	1.32	1.12, 1.56	1.31	1.11, 1.55
Alcohol-related disease	1.31	1.11, 1.53	2.39	1.80, 3.19	2.26	1.70, 2.99
Suicide	1.52	1.36, 1.69	2.84	2.35, 3.45	2.72	2.25, 3.29
Under-educated women						
Matched (Ref.)	1.00		1.00		1.00	
All causes	0.94	0.93, 0.96	0.79	0.76, 0.82	0.81	0.78, 0.84
Cancer	0.90	0.88, 0.92	0.82	0.78, 0.86	0.83	0.80, 0.87
All circulatory disease	1.03	1.00, 1.07	0.79	0.74, 0.85	0.81	0.76, 0.87
Ischaemic heart disease	1.06	1.01, 1.11	0.78	0.71, 0.86	0.80	0.72, 0.88
Stroke	0.95	0.89, 1.01	0.72	0.63, 0.82	0.73	0.63, 0.83
Alcohol-related disease	1.05	0.94, 1.18	0.61	0.48, 0.78	0.67	0.52, 0.85
Suicide	0.73	0.66, 0.80	0.69	0.57, 0.84	0.74	0.61, 0.90
−2 Log likelihood ratio test						
	Chi-squared[d]	d.f.	P <	Chi-squared[e]	d.f.	P <
All cause	8305.9	37	.0005	7309.6	1	.0005
Cancer	2960.9	37	.0005	1973.7	1	.0005
All circulatory disease	1812.3	37	.0005	1250.5	1	.0005
Ischaemic heart disease	600.7	37	.0005	219.7	1	.0005
Stroke	1154.3	37	.0005	633.5	1	.0005
Alcohol-related disease	979.7	37	.0005	999.4	1	.0005
Suicide	2053.2	37	.0005	1390.3	1	.0005

Note: HR, hazard ratio, CI, confidence interval.

[a]Adjusted for birth cohort, over-educated status, under-educated status, foreign born status, interaction term (foreign born*over-educated), interaction term (foreign born*under-educated).

[b]Additional adjustment for the natural logarithm (no. of children), marital status, natural logarithm (total income), education level, total cumulative unemployment experience 1990–2008, employer county location, and employer industry sector.

[c]Additional adjustment for natural logarithm (no. of total hospitalisations).

[d]Compares (−2LL Model 2 – −2LL Model 1); test statistics are identical for the over-educated and under-educated.

[e]Compares (−2LL Model 3 – −2LL Model 2); test statistics are identical for the over-educated and under-educated.

Likelihood ratio testing suggests that global model fit improved across all of the models once the indicator for prior health status was included.

Excessive mortality related to an over-educated status is evident for all causes (HR 1.40, 95% CI 1.35, 1.45), cancer mortality (HR 1.38, 95% CI 1.31, 1.45), CD-related mortality (HR 1.33, 95% CI 1.21, 1.46), IHD (HR 1.36, 95% CI 1.19, 1.57), stroke (HR 1.31, 95% CI 1.11, 1.55), alcohol-related disease mortality (HR 2.26, 95% CI 1.70, 2.99) and suicide (HR 2.72,

95% CI 2.25, 3.29). Findings from age-cohort stratified models for all causes of mortality (Table 4) suggest that the hazard of mortality from over-education was mostly attributable to women born between 1940 and 1969.

Discussion

A stable over-educated status produces excessive mortality in Swedish men and women after controlling for SFE characteristics and prior poor health status. Among women, excessive mortality is evident for all causes and each of the specific causes of death examined. Among men, elevated all-cause mortality resulting primarily from excess cancer, alcohol-related disease and suicide mortality is clear. These findings provide partial support for hypothesis 1 and strong support for hypotheses 2 and 3.

It is possible that many over-educated individuals who died during the study follow-up experienced long-term, intensive, psycho-social stress over time. A discrepancy between educational and occupational attainment is likely to have produced a sense of relative deprivation among these individuals (Burris 1983), and more so in individuals who are highly educated but working in occupations where their qualifications, skills and abilities exceed those of most they work with or for. Such individuals are likely to experience reduced prestige (Burris 1983) and reduced earnings (Hartog 2000, Nordin *et al.* 2010). The knowledge, skills and abilities that may have taken considerable resources, time and effort to hone, atrophy or depreciate in value.

The descriptive information provides some support for part of this narrative in relation to over-educated women and the potential salience of a material pathway in the development of stress. Over-educated women were disproportionately unmarried but they also had a lower average income in contrast to women who were classified as matched. For men there was no evidence of a lower average income as a result of being over-educated when compared with matched men. This finding appears to diverge from a recent Swedish study that suggested that both highly educated mismatched native-born men and women experienced an income penalty (Nordin *et al.* 2010). However, the more diverse group of occupations represented among over-educated men in this study could explain this discrepancy.

It is also plausible that a perceived status discrepancy is partially responsible for these findings. Elevated suicide mortality among over-educated men and over-educated women suggest a psycho-social pathway for both. Stress from an over-educated status has been shown to be associated with a higher level of depression (Bracke *et al.* 2013), greater distress and shame (Lundberg *et al.* 2009), feelings of hopelessness and alienation (Burris 1983) and reduced psychological wellbeing (Cassidy and Wright 2008), compared with those who were classified as matched or status congruent.

There is also support for the idea that over-educated women and men engage in maladaptive coping behaviour when they are stuck over the long term in unstimulating, passive jobs that fail to utilise the education and skills that they acquired through formal schooling. Both groups showed elevated cancer and alcohol-related mortality independent of prior hospitalisations, which included prior cancer and alcohol-related disease admissions. Finally, there is elevated CD, IHD and stroke mortality for women but not for men. This provides mixed support for the idea that psycho-social stress from over-education may lead to a higher hazard of death from CD. Elevated CD and IHD findings for women are suggestive of a psycho-social pathway or maladaptive coping behaviour.

Some may be inclined to interpret the excess hazard of mortality from an over-educated status as a form of unobservable selection. For example, those who have health problems, diffi-

cult personalities or lower productivity or ability might be more likely to be over-educated and actively seek employment where work is less demanding. However, evidence from a recent Swedish study (Nordin *et al.* 2010) could not attribute an observed income penalty among a cross-section of native-born, mismatched Swedish men to lower ability (measured by IQ). Unfortunately, this study did not have IQ data for women to further test the lower ability hypothesis.

Health selection is not likely to be a factor either. This study shows mostly a small reduction in the hazard ratios of over-educated people after adjusting for prior hospitalisations. Additional analysis also ensured that the measure of prior health status was not sensitive to the effect of income, education or geographical location.

It is difficult to offer much insight about the roles of personality characteristics or productivity among these workers. An alternative explanation could shift focus from the supply side to the demand side and instead suggest that employers might infer negative personality traits or lower productivity among those who have been employed in jobs where their education and skills exceed those obtained by most others in their respective occupations. It is possible that once an individual takes employment that is not well matched to their educational background (for example, a college graduate working in the food service or transport sectors) their later transfer to an occupation that more suitably matches their attained education could become more difficult. Employers might also consider the effects of skill depreciation on initial productivity dependent on the length of time the prospective worker has spent employed in a job that they are over-qualified for.

There is convincing evidence that employers behaved like this in the case of workers exposed to long-term unemployment during the Great Recession in the USA (Guryan and Charles 2013, Kroft *et al.* 2013) and also in Sweden, when recent unemployment experience lasted at least 9 months (Eriksson and Rooth 2014). Findings from these studies suggested that employers were less likely to call back fictitious job applicants if they had a history of long-term unemployment. It is possible that employers used long-term unemployment experience as a way to filter out candidates they felt were less desirable.

Contrary to hypothesis 4, the findings demonstrate that a long-term, under-educated status has a protective effect. Workers with the lowest level of attained education usually have the worst outcome in studies of mortality (Elo and Preston 1996, Marmot *et al.* 1997). It may seem paradoxical that these workers had lower excessive mortality relative to their matched and over-educated counterparts. However, this finding could be interpreted in the following ways. First, these workers were mostly employed in occupations that were less likely to have strict, formal educational requirements. Many of these occupations could have provided an opportunity to obtain additional job specific education or training if needed as a condition for employment.

Human capital theory on the training investment of firms and workers supports the first interpretation. The theory predicts that employers will not consistently hire individuals with below average educational attainment or skills for jobs that demand high marginal productivity (Becker 1993). The productivity of such candidates would be compromised and this would make them costly to the firm to hire. Such individuals instead, are more likely to be hired in jobs that have lower skill and educational requirements. These jobs may necessitate additional firm-specific training in order to meet productivity demands. Usually the employer subsidises the cost of such training because it cannot be used in other firm work contexts. Firms pay trainees a lower wage during the training period to offset the cost of their lower marginal productivity.

However, the prospective employee usually has to agree to the training in order to gain employment. This suggests a degree of decision latitude about the skill acquired. In this case,

the under-educated worker would be situated in a relatively low strain work context irrespective of job demands. The JDC framework suggests that this type of employment situation would not generate health-damaging stress. Employers will also offer a higher wage after the training has been completed as an incentive to finish the training and stay with the firm so that it can recoup the cost of the training (Becker 1993). If compensation matches the worker's productivity after the training has been completed the ERI framework does not predict harmful effects to health either.

It is also possible that the under-educated workers in this study benefitted from better working conditions as a result of union-gained protections and concessions. While Swedish labour union participation has fallen since 1995, membership is still relatively high compared to most other European Union countries (Visser 2013). In 2008 69% of Swedish wage workers were members of a labour union and over 90% of these workers were covered by some form of a collective bargaining agreement (Visser 2013). Occupations in this study that had the highest number and proportion of stable status, under-educated workers in both 1990 and 2008 included many heavily unionised industries and occupations (for example, lorry drivers, construction of residential and non-residential buildings, electrical installation, forest management, machining, compulsory comprehensive school education and printing). But this reasoning is speculative because the study did not have information on union membership or the degree of unionisation at the occupation level to directly assess the effects of these potential factors.

It is worth noting that the results of this study are comparable to the set of findings from a much larger group of studies that have suggested that negative health and mortality effects are found predominantly among over-educated, over-qualified or under-employed people rather than the under-educated, under-qualified and over-employed individuals. In comparison to the two earlier mortality studies, findings from this study are simultaneously similar and dissimilar. When compared with the Smith *et al.* (2012) study, the magnitude of all causes, CVD and CD mortality estimates were very close for over-educated men. The estimates for over-educated women were not. However, the protective effect of under-education and under-qualification was consistent in both studies, although the magnitude of the estimates was larger in this study.

A comparison with the older Faresjo *et al.* (1997) study is more tenuous, given the differences in the samples and statistical methods. However, the results of both studies taken together are again suggestive of an excessive hazard of mortality in those with an over-educated status. This study is more comprehensive than the two earlier mortality studies as it has also considered the relationship between educational mismatch and other specific causes of death in addition to CVD and cancer.

Limitations and advantages

This study focused specifically on individuals with a stable matched and mismatched status over time, in part, to make the process of comparison straightforward. Therefore, generalisations about the mortality effects of over-education or under-education cannot be extended to individuals who experienced changes in their matched or mismatched status. These individuals were not included in this study. Additionally, this study did not consider the potential effects of changes in SFE characteristics among those with a stable matched or mismatched status.

It is also worth noting that formal educational requirements of jobs are only one type of skill that may be needed (Garcy and Bridges 1997) for employment. In many lower level occupations, educational requirements will in fact be minimal. Hence, it is possible that a worker can be mismatched on the dimension of education but matched or become matched on other dimensions (for example, work experience, job-specific training or language skills). The data available in this study did not allow for an assessment of whether other types of skills

have been acquired in addition to, or as a substitute for formal schooling. Information on other employer required forms of skill or training were not available. However, this consideration may offer some indication as to why under-educated, native-born Swedish workers in this study have lower mortality than workers who were always matched or over-educated.

It is also possible that an objective measure of educational mismatch over-identifies subjective feelings of discordance and resultant psycho-social stress. Obviously, not all individuals who are over-educated will be preoccupied with their social and occupational standing in relation to others. Psycho-social stress can also arise for other reasons related to over-education, including low pay, poor working conditions and the depreciation of their skills.

Subjectively reported measures might seem better suited for investigating health outcomes. However, it has been shown in an earlier work (Clogg and Shockey 1984) that subjective measures may not reflect objective educational requirements in occupations. Subjective responses are also likely to be confounded by age, work experience and gender, and are likely to capture both transient and chronic feelings of stress if attitudes are assessed at a single time point only. While this study utilises an objective measure of mismatch, it has the clear advantage of more accurately identifying long-term stress that could result from an unchanging, over-educated employment status because it is also a longitudinal measure. It was argued that for negative health effects to accumulate and contribute or lead to death, educational mismatch would have had to produce significant, prolonged, psycho-social stress.

Other advantages of this study include the use of a very large sample of individual Swedish workers and high quality register data that facilitated the construction of a straightforward and transparent method for assessing educational mismatch. The study was also able to simultaneously control for the main effects of several different status hierarchies. Finally, the study utilised a longitudinal design. Most other studies of status incongruence and health outcomes have been cross-sectional. Causal inference is stronger in the former case.

Conclusion

The study findings suggest excessive mortality among over-educated people, and a protective effect of under-education among native-born Swedish men and women whose mismatched status was stable over time. In the case of over-educated workers, these findings are supportive of predictions by the JDC and ERI frameworks about the negative health effects of exposure to long-term psycho-social stress. They are also consistent with the idea that a discordance between an individual′s realised position in a status hierarchy and the individual's perception about where they ought to be positioned in it could affect their health negatively.

The consistent, protective effect of a stable under-educated status is somewhat more difficult to fully explain, given the study's database limitations. However, these findings are not incompatible with the JDC and ERI framework predictions if other additional evidence is considered at the same time. Theory on the training investment of firms and workers and the aforementioned descriptive information on unionisation in Sweden offer some insights. The opportunity to obtain additional skills and training combined with union-won concessions could reduce the potential for health-harming psycho-social stress among these native-born Swedish workers. Finally, there are several planned future extensions of this research including a consideration of the possible effects of different trajectories of matched or mismatched statuses on mortality, an assessment of whether a dose-response relationship exists and an assessment of the potential role that changes in various SFE characteristics might have on mortality among individuals who experienced both stable and varying trajectories of matched and mismatched status over time.

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Appendix 1: Codes for specific causes of mortality in ICD 9 and ICD 10

Cancer mortality: ICD-9:150–239.9; ICD-10: C00-D48.9

Circulatory disease (CD) mortality: ICD-9: 342–342.9, 391–460; ICD-10: I00-I99, G810-G811, G819 Ischaemic heart disease: ICD-9:410–430;ICD-10: I20-I25.9

Stroke: ICD-9: 430–439, 342–342.9; ICD-10: I60-I69.8, G810-G811, G819

Alcohol disease-related mortality: ICD-9: 2550, 2910–2915, 2918–2919, 2922, 303, 3050, 3575, 3594, 4255, 5353–5355, 5710–5713, 5728, 5770–5771, 6554, 7598, 7607, 9800–9809; ICD-10: E244, F10-F10.9, G312, G621, G721, I426, K292, K700-K709, 0354, P043, Q86, T510-T519, X45, X65, Y15, Y901-Y909, Y912-Y919

Suicide: ICD-9: E950–E959; ICD-10: X60–X84, Y870